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(54) Title: PLANET SHAFT LOCATING PIN

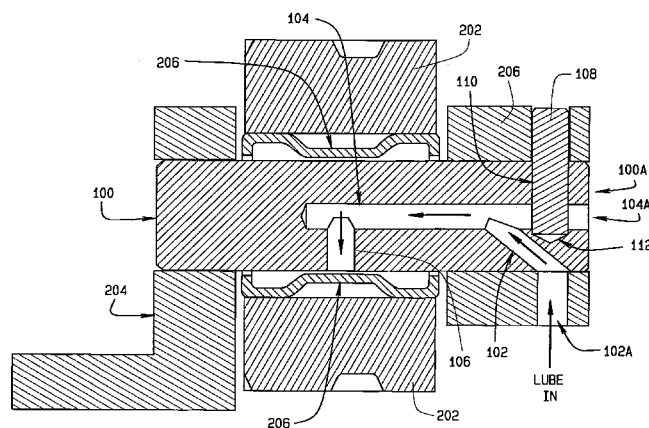


FIG. 3

(57) Abstract: A method and apparatus for sealing an axial lubrication bore 104 within a planetary gear set 200 having a planetary gear 202 axially supported about a planetary gear shaft 100 and carried within a planetary gear carrier 204. Within the planetary gear shaft 100, the axial lubrication bore 104, having at least one axial opening 104A and at least two intersecting lubrication flow bores 102, 106, is sealed at the axial opening 104A by a radially disposed planet shaft locating pin 108 which holds the planetary gear 202 in relation to the planetary gear carrier 204. The planet shaft locating pin 108 is seated within a radial bore 110 which intersects and passes through the axial lubrication flow bore 104 adjacent the axial opening 104A. The length of the planet shaft locating pin 108 sufficiently exceeds the radial dimension of the planetary gear shaft 100 so as to ensure at least a portion of the planet shaft locating pin 108 seats within an internal recess 112 disposed in the axial lubrication flow bore sidewall, radially opposite from the radial bore 110. The planet shaft locating pin 108 has a diameter which fully occludes the axial lubrication bore 104 when seated within the internal recess 112.



-1-

PLANET SHAFT LOCATING PIN

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is related to, and claims priority from, U.S. Provisional Patent Application Serial No. 61/026,907 filed on February 7, 2008, and which is
5 herein incorporated by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

Not Applicable.

BACKGROUND OF THE INVENTION

The present invention is related generally to planetary gear sets, and in
10 particular, to a planetary gear shaft having a locating pin for holding the planetary gear shaft in a planetary gear carrier and for concurrently sealing an axial lubrication bore hole in the planetary gear shaft.

For various applications, it is necessary to provide a flow of a lubricant through an axial lubrication bore of a shaft, with the flow of the lubricant entering the
15 axial lubrication bore via a first radially directed passage adjacent an axial end of the shaft, and exiting the axial lubrication bore at one or more desired locations via additional radially directed passages. One such application utilizing an axial lubrication bore in a shaft is found in a planetary gear set having a planetary gear axially supported about a planetary gear shaft and carried within a planetary gear
20 carrier. The planetary gear shaft is held within the planetary gear carrier by a planet shaft locating pin extending radially outward from a bore drilled across the diameter of the planetary gear shaft, adjacent to an axial end thereof. As shown in Figures 1A and 1B, a flow of lubricant is directed into an axial lubrication bore of the planetary gear shaft through the portion of the cross-diameter bore which is
25 unobstructed by the planet shaft locating pin and which intersects the axial lubrication bore. The flow of lubricant moves axially within, and subsequently exits, the axial lubrication bore at one or more desired locations, such as adjacent to planet gear bearings, via one or more additional radial outlet bores. Traditionally, any axial end openings of the axial lubrication bore, which remain from a boring or
30 machining operation to produce the axial lubrication bore, are sealed with pressed

-2-

axial plugs prior to use, requiring additional machining and/or manufacturing steps to complete the closure process before the introduction of a lubricant flow through the axial lubrication bore.

Accordingly, it would be advantageous to provide a shaft having an axial
5 lubrication bore with a means and method for sealing any associated axial openings without requiring the use of axially pressed plugs or additional manufacturing steps.

BRIEF SUMMARY OF THE INVENTION

Briefly stated, in one embodiment, the present disclosure provides a method
for sealing an axial lubrication bore in a shaft having an axial lubrication bore which
10 includes at least one axial opening and two or more radially intersecting lubrication flow bores. The axial opening of the lubrication bore is sealed by a radially disposed shaft locating pin seated within a radial bore which intersect and passes through the axial lubrication flow bore adjacent the axial opening. The length of the shaft locating pin is selected to exceed the radial dimension of the shaft, so as to ensure at least a
15 portion of the shaft locating pin seats within an internal recess in the inner sidewall of the lubrication bore, radially in-line with the radial bore receiving the shaft locating pin. The shaft locating pin is further selected to have a diameter which fully occludes the axial lubrication bore as the shaft locating pin is passed through the radial bore and seated within the internal recess.

20 In an alternate embodiment, the present disclosure provides a planetary gear set having a planetary gear axially supported about a planetary gear shaft and carried within a planetary gear carrier. Within the planetary gear shaft, an axial lubrication bore having an axial opening and two or more radially intersecting lubrication flow bores is sealed in proximity to the axial opening by a radially
25 disposed planet shaft locating pin which holds the planetary gear shaft within the planetary gear carrier. The planet shaft locating pin is seated within a radial bore which intersects, and passes, through the axial lubrication flow bore adjacent to the axial opening. The length of the planet shaft locating pin sufficiently exceeds the radial dimension of the planetary gear shaft so as to ensure at least a portion of the
30 planet shaft locating pin seats into a recess in the sidewall of the axial lubrication

-3-

bore radially opposite from the radial bore within the planetary gear shaft. The planet shaft locating pin further has a diameter fitted to the radial bore which fully occludes the axial lubrication bore, functioning to seal it from the axial opening.

5 In an alternate embodiment, the present disclosure provides a method for sealing an axial opening in an axial lubrication bore of a planetary gear shaft by seating a planet shaft locating pin having a diameter which exceeds the diameter of the axial lubrication bore within a fitted radial bore intersecting and passing through the axial lubrication bore.

10 The foregoing features, and advantages set forth in the present disclosure as well as presently preferred embodiments will become more apparent from the reading of the following description in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

In the accompanying drawings which form part of the specification:

15 Figure 1A is a cross-sectional view of a prior art planet shaft with an axial plug;

Figure 1B is an axial-end sectional view of the prior art planet shaft of Fig. 1A;

Figure 2A is a cross-sectional view of a planet shaft of the present disclosure with a locating pin occluding an axial lubrication bore;

Figure 2B is an axial-end sectional view of the planet shaft of Fig. 2A; and

20 Figure 3 is a partial cross-sectional view of a planetary gear assembly, illustrating the placement of the planet shaft of Fig. 2A within the assembly and a lubrication flow path.

Corresponding reference numerals indicate corresponding parts throughout the several figures of the drawings. It is to be understood that the drawings are for
25 illustrating the concepts set forth in the present disclosure and are not to scale.

Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings.

DETAILED DESCRIPTION

The following detailed description illustrates the invention by way of example and not by way of limitation. The description enables one skilled in the art to make and use the present disclosure, and describes several embodiments, adaptations, variations, alternatives, and uses of the present disclosure, including what is presently believed to be the best mode of carrying out the present disclosure.

Turning to the figures, and to Figures 2A and 2B in particular, a planetary gear shaft 100 of the present disclosure is shown. The planetary gear shaft 100 is configured generally for use in a planetary gear set 200, as shown in Figure 3, having a planetary gear 202 which is axially supported about the planetary gear shaft 100 while the shaft 100 is carried within a planetary gear carrier 204. As seen in Figures 2A and 3, within the planetary gear shaft 100, lubrication flow is directed via a generally radial lubrication input port 102 into an axial lubrication bore 104, and exits the axial lubrication bore 104 via one or more generally radial lubrication output ports 106 in proximity to bearings 206 or other components requiring lubrication. The position of the input port 102 is selected so as to receive a flow of lubricant from the environment of the planetary gear shaft 100, while the position of each of the output ports 106 is selected to direct the exiting flow of lubrication to a preferred locations, such as adjacent to bearings 206 supporting the planet gear 202. The axial lubrication bore 104 coupling the input port 102 and the output ports 106 preferably includes a single axial opening 104A in an axial end 100A of the planetary gear shaft 100, as best seen in Figure 2A.

To prevent a loss of lubricant from the axial lubrication bore 104, the axial opening 104A in the planetary gear shaft 100 is blocked or sealed by a radially disposed planet shaft locating pin 108 which facilitates proper positioning of the planetary gear 202 on the planetary gear shaft 100 relative to the planet carrier 204 by securing a suitable spacer 206 to the planet shaft 100. The planet shaft locating pin 108 is seated within a radially aligned pin bore 110 in the planetary gear shaft 100, which intersect and passes through the axial lubrication flow bore 104 adjacent to the axial opening 104A. The length of the planet shaft locating pin 108 sufficiently

-5-

exceeds the radial dimension of the planetary gear shaft 100, so as to ensure at least a portion of the planet shaft locating pin 108 seats into an internal recess 112 which is disposed in the sidewall of the axial lubrication flow bore 104 radially opposite from the pin bore 110 within the planetary gear shaft 100. The recess 112 may be formed by an extension of the pin bore 110 which extends beyond the axial midpoint of the planetary gear shaft 104. The planet shaft locating pin 108, and correspondingly the pin bore 110, each have a diameter which is sufficiently large enough to fully occlude the axial lubrication bore 104 when the locating pin 108 is seated there in. To permit the introduction of lubricant into the axial lubrication bore 104, the lubrication input port 102 may be aligned at an angle relative to the axial lubrication bore 104, as seen in Figures 2A and 3, permitting the external opening 102A of the lubrication input port 102 to be disposed diametrically opposite from the portion of the planet shaft locating pin 108 protruding from the locating pin bore 110 without interfering with the internal recess 112 into which the planet shaft locating pin 108 is seated internally within the planetary gear shaft 100.

In an alternate embodiment, the present disclosure provides a method for sealing an axial opening 104A in an axial lubrication bore 104 of a planetary gear shaft 100 by seating a planet shaft locating pin 108 having a diameter greater than the diameter of the axial lubrication bore 104 within an associated pin bore 110 which intersects, and passes through, the axial lubrication bore 104 adjacent to the axial opening 104A. The planet shaft locating pin 108 is seated within the pin bore 110, and engaged with an internal recess 112 disposed in the sidewall of the axial lubrication bore 104, such that the planet shaft locating pin 108 fully occludes the axial lubrication bore 104 in the vicinity of the axial opening 104A.

As various changes could be made in the above constructions without departing from the scope of the disclosure, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense. For example, those of ordinary skill in the art will recognize that the apparatus and methods of the present disclosure as set

-6-

forth herein are not limited to use with planetary gear shafts 100, but may in fact, be used to provide a seal for axial lubrication bores in a variety of shaft assemblies.

-7-

CLAIMS:

1. An improved planet shaft (100) for use in a planetary gear set (200) having a planetary gear (202) axially supported about the planetary gear shaft (100) and carried within a planetary gear carrier (204), comprising

5 a planet shaft locating pin (108) seated within a locating pin bore (110) of the planet shaft (100) adjacent an axial end (100A) of the planet shaft (100);

wherein said planet shaft (100) includes an axial lubrication bore (104) having at least one axial opening (104A), an input lubrication flow bore (102) for directing a lubricant flow into said axial lubrication bore, and at least one lubrication output flow
10 bore (106) for delivering lubricant flow from said axial lubrication bore (104) to a desired external location on said planet shaft (100); and

wherein said planet shaft locating pin (108) is fitted within said locating pin bore 108 and seated in an internal recess (112) in the internal sidewall of the axial lubrication bore (104), such that said planet shaft locating pin (108) fully occludes
15 said axial lubrication bore (104) adjacent said axial opening (104A).

2. The improved planet shaft of Claim 1 wherein said locating pin (108) has a diameter greater than a diameter of said axial lubrication bore (104).

3. The improved planet shaft of Claim 1 wherein said locating pin (108) has a length which exceeds a radial dimension of said planet shaft (100).

20 4. The improved planet shaft of Claim 1 wherein said input lubrication flow bore (102) is aligned at an acute angle relative to said axial lubrication bore (104) and has an external opening (102A) diametrically opposite from said locating pin bore (110).

5. An improved gear support shaft (100) having an axial lubrication bore (104) with an open axial end (104A) through which a lubricant flows between an input lubrication port (102) and an output lubrication port (106), comprising:
25

a locating pin (108) seated within a locating pin bore (110), said locating pin bore (110) radially intersecting and passing through said axial lubrication bore (104) adjacent to the open axial end (104A) at an axial end (100A) of the gear support
30 shaft (100); and

-8-

wherein said locating pin (108) is dimensioned to occlude said axial lubrication bore (104) when seated within said locating pin bore (110), and to extend radially outward from an exterior surface of the gear support shaft (100).

6. The improved gear support shaft of Claim 5 wherein said locating pin bore (110) is perpendicular to said axial lubrication bore (104).

7. The improved gear support shaft of Claim 5 wherein said locating pin bore (110) terminates in a recess (112) disposed in an sidewall surface of said axial lubrication bore (104).

8. A method for sealing an axial opening (104A) of an axial lubrication bore (104) in a shaft (100), comprising:

disposing, within said shaft (100), in proximity to said axial opening (104A), a pin receiving bore (110) having a diameter exceeding a diameter of said axial lubrication bore (104), said pin receiving bore (110) intersecting and passing through said axial lubrication bore (104) to terminate in a recess (112) in a sidewall surface of said axial lubrication bore (104); and

seating a fitted pin (108) within said pin receiving bore (110) and in engagement with said recess (112) to occlude said axial lubrication bore (104) adjacent said axial opening (104A).

9. The method of Claim 8 wherein said shaft (100) is a planet shaft supporting a planet gear (202) within a planetary gear set (200); and

wherein said pin (108) is configured to secure said planet gear (202) on said planet shaft relative to a planet carrier (204).

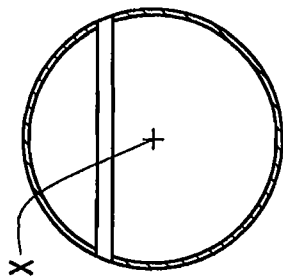


FIG. 1B
PRIOR ART

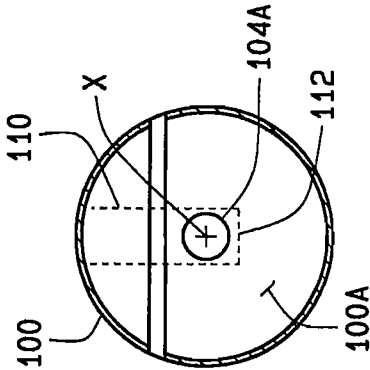


FIG. 2B

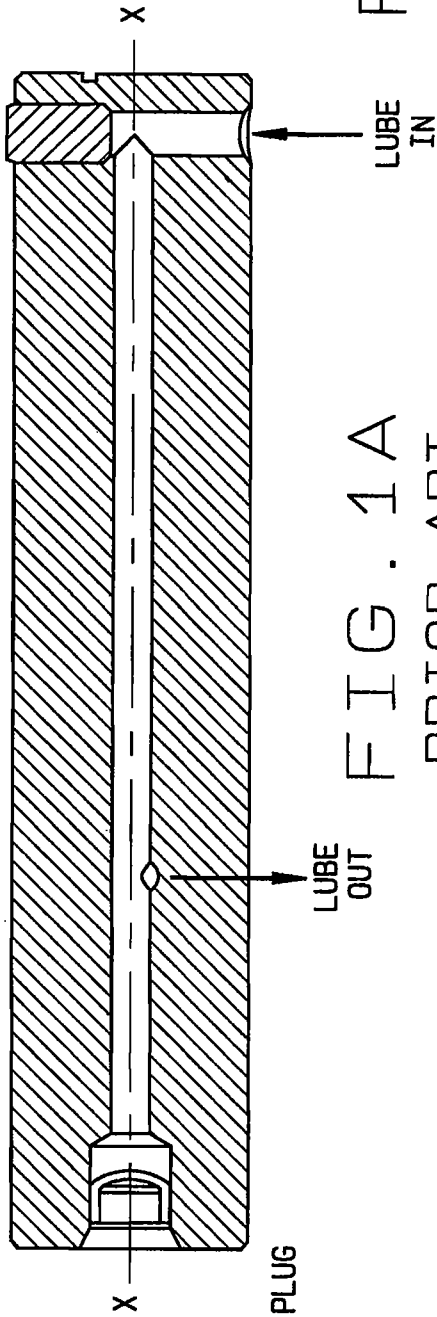


FIG. 1A
PRIOR ART

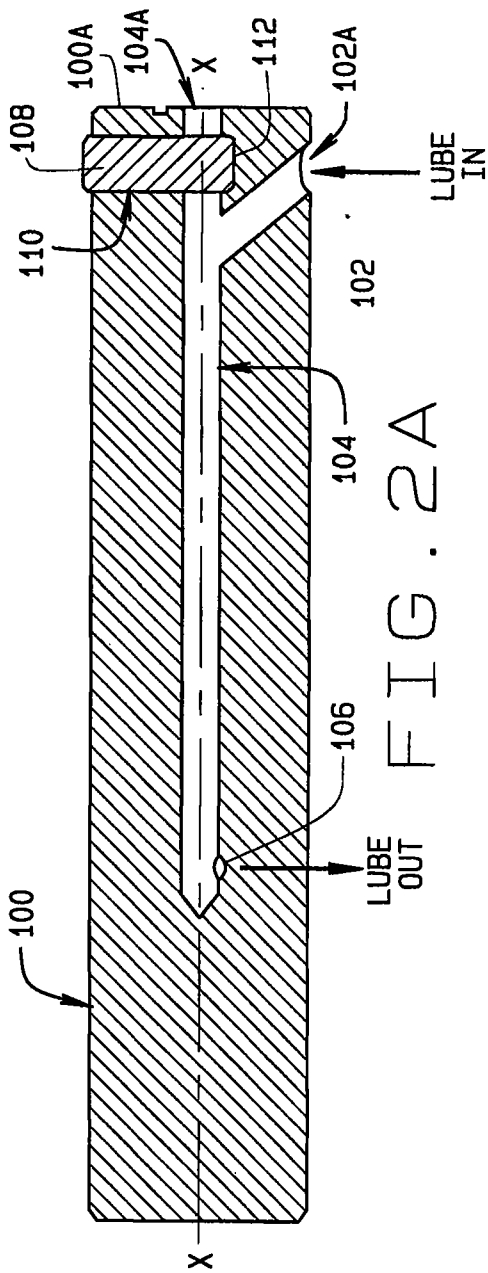


FIG. 2A

2/2

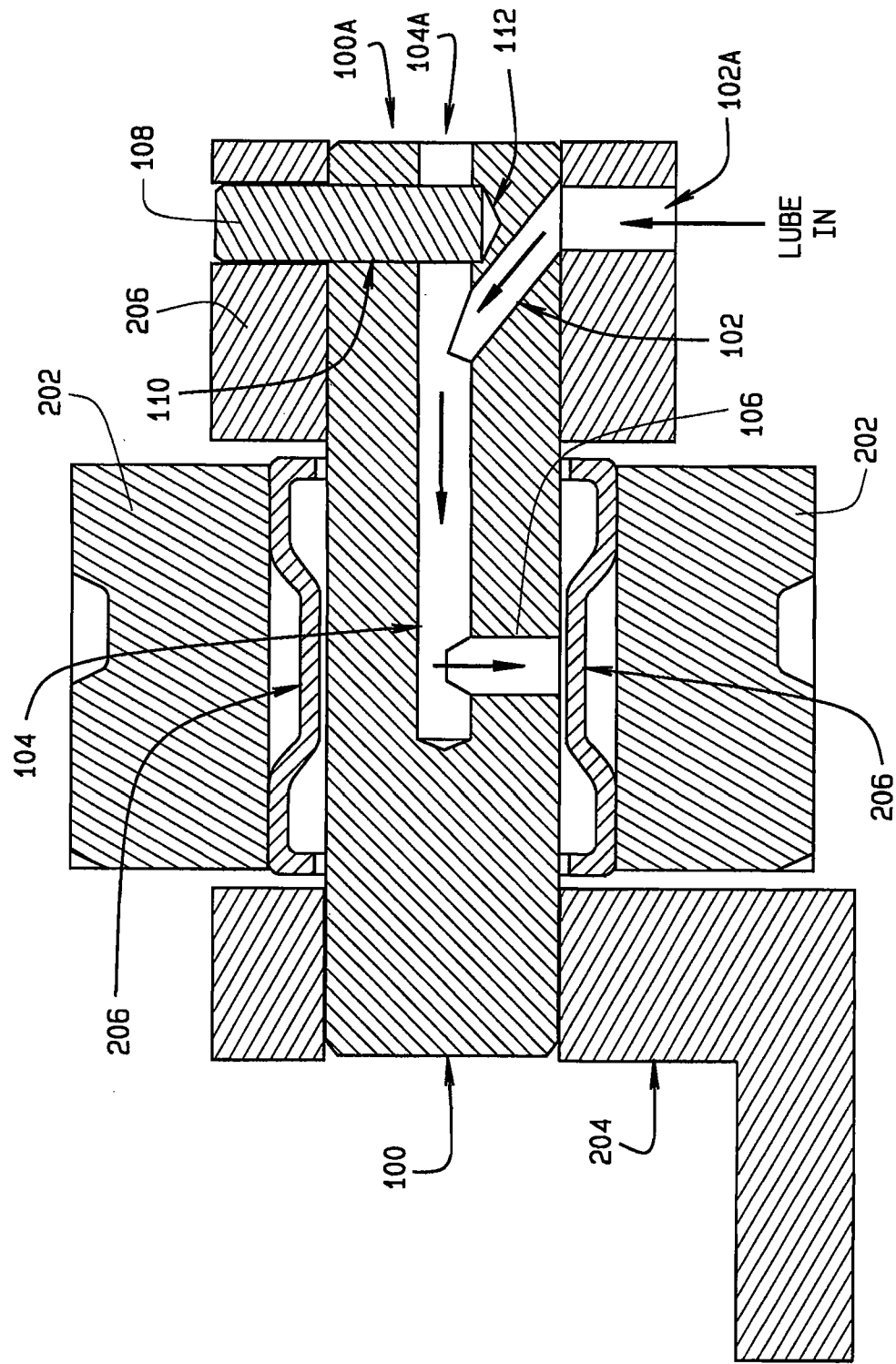


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2009/033194

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16H57/04 F16H57/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 08 014369 A (NIPPON SEIKO KK) 16 January 1996 (1996-01-16) the whole document	1-9
X	JP 07 317885 A (NIPPON SEIKO KK) 8 December 1995 (1995-12-08) the whole document	1-6
A	JP 2007 113625 A (JTEKT CORP) 10 May 2007 (2007-05-10) the whole document	1, 5, 8
A	US 2007/066440 A1 (KITAHARA TETSUROU [JP] ET AL) 22 March 2007 (2007-03-22) figure 6 ----- -/-	1, 5, 8

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *G* document member of the same patent family

Date of the actual completion of the international search

6 May 2009

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2009/033194

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 403 558 A (NISSAN MOTOR [JP]) 31 March 2004 (2004-03-31) paragraph [0058]; figure 3 -----	1,5,8
A	JP 2000 337484 A (DAIHATSU MOTOR CO LTD) 5 December 2000 (2000-12-05) the whole document -----	1,5,8
A	US 5 928 100 A (OHTAKE ISAMU [JP] ET AL) 27 July 1999 (1999-07-27) claims 1,2 -----	1,5,8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2009/033194

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 8014369	A	16-01-1996	NONE	
JP 7317885	A	08-12-1995	NONE	
JP 2007113625	A	10-05-2007	NONE	
US 2007066440	A1	22-03-2007	CN 1936361 A JP 2007085409 A	28-03-2007 05-04-2007
EP 1403558	A	31-03-2004	US 2004060774 A1	01-04-2004
JP 2000337484	A	05-12-2000	JP 3522152 B2	26-04-2004
US 5928100	A	27-07-1999	JP 3698816 B2 JP 10019111 A	21-09-2005 23-01-1998